REMARKS

Claims 1, 6, 16, 21, 31 and 36 stand rejected under 35 U.S.C. § 102(e) as being anticipated by Chang et al. (U.S. Patent No. 6,162,684) ("Chang"). The rejection is respectfully traversed.

The present invention relates to a method of forming a flash memory cell utilizing atomic oxidation for fabrication of a second or top oxide layer in an oxide-nitride-oxide insulating structure. As such, independent claim 1 recites a "method of forming a flash memory cell" by "forming a first conductor layer over" a tunnel oxide and "forming an insulating layer over the first conductor layer." Independent claim 1 further recites that the insulating layer comprises "a first oxide layer over the first conductor layer, a nitride layer over the first oxide layer, and a second oxide layer over the nitride layer . . . formed by oxidizing said nitride layer with an ambient containing atomic oxygen."

Independent claim 16 recites a "method of forming an ONO insulating structure" by "depositing a first oxide layer over an integrated circuit structure; depositing a nitride layer over said first oxide layer; and growing a second oxide layer over said nitride layer . . . by oxidizing said nitride layer in the presence of atomic oxygen." Independent claim 31 further recites a "method of forming a flash memory array containing a plurality of flash memory cells" by "forming a tunnel oxide on a substrate; forming a first conductor layer over the tunnel oxide" and "forming an insulating layer over the first conductor layer." Independent claim 31 further recites that the insulating layer comprises "a first oxide layer over the first conductor layer, a nitride layer over the first oxide layer, and a second oxide layer over the nitride layer . . . formed by oxidizing said nitride layer in the presence of atomic oxygen."

Chang relates to an "ammonia annealed and wet oxidized LPCVD oxide" which replaces "ONO films for high integrated flash memory devices." (Title). According to Chang, the interpoly dielectric layer which replaces ONO films "is formed by a three step process." (Col. 4, lines 45-46). In particular, "the process conditions for forming the

interpoly dielectric layer involve depositing the initial oxide layer by low pressure chemical vapor deposition (LPCVD), followed by ammonia annealing the initial oxide layer, and finally wet oxidizing the oxide layer." (Col. 4, lines 46-50).

Chang does not disclose the limitations of claims 1, 6, 16, 21, 31 and 36. Chang does not disclose the steps of forming "a *first oxide layer* over the first conductor layer, a nitride layer over the first oxide layer, and a *second oxide layer* over the nitride layer . . . formed by oxidizing said nitride layer with an ambient containing atomic oxygen," as independent claim 1 recites (emphasis added). Chang teaches the formation of a *single* interpoly dielectric layer by depositing an initial oxide layer and then subjecting *the same initial oxide layer* to an ammonia annealing and a wet oxidation. Chang does not teach or suggest the formation of an oxide layer, followed by the formation of a nitride layer and the formation of a second oxide layer, as in the claimed invention.

Further, Chang is silent about a "method of forming an ONO insulating structure," much less about an *ONO insulating structure* formed by "depositing a *first oxide layer* over an integrated circuit structure; depositing a nitride layer over said first oxide layer; and growing a *second oxide layer* over said nitride layer. . . by oxidizing said nitride layer in the presence of atomic oxygen," as independent claim 16 recites (emphasis added). The Office Action asserts that "[C]learly, Figure 1 (of Chang) is an ONO layer." (Office Action at 3). Applicants note, however, that although Chang illustrates a "conventional" ONO structure in the background section, the conventional ONO structure of Chang is not formed by *inter alia*, "growing a *second oxide layer* over said nitride layer . . . by oxidizing said nitride layer in the presence of atomic oxygen," as independent claim 16 recites (emphasis added). In fact, Chang teaches against using an ONO structure. Chang expressly notes that the "ammonia annealed and wet oxidized LPCVD oxide" replaces "ONO films for high integrated flash memory devices." (Title; Col. 4, lines 39-50).

Chang is also silent about a "method of forming a flash memory array," much less about "a plurality of flash memory cells" formed *inter alia* by forming "a first oxide layer over the first conductor layer, a nitride layer over the first oxide layer, and a second

oxide layer over the nitride layer . . . by oxidizing said nitride layer in the presence of atomic oxygen," as independent claim 31 recites. In sum, Chang does not disclose the limitations of claims 1, 6, 16, 21, 31 and 36 and the present invention is not anticipated under 35 U.S.C. § 102.

Claims 2-5, 11-15, 17-20, 26-30, 32-35 and 41-45 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Chang et al. (U.S. Patent No. 6,162,684) ("Chang"). The rejection is respectfully traversed.

Claims 2-5, 17-20 and 32-35 depend on independent claims 1, 16 and 31, respectively, and recite that the second oxide layer is grown "at a temperature of about 850°C to about 1100°C" (claims 2, 17 and 32), "at a temperature of less than about 900°C" (claims 3, 18 and 33), "for about 1 second to about 10 minutes" (claims 4, 19 and 34) and "to at least about 60% of a targeted thickness of said second oxide layer" (amended claims 5, 20 and 35). Claims 11-15, 26-30 and 41-45 depend on independent claims 1, 16 and 31, respectively, and recite that the second oxide layer "is formed in a single wafer system" (claims 11, 26 and 41), "in a batch furnace system" (claims 12, 27 and 42), "in a rapid thermal system" (claims 13, 28 and 43), "in a fast ramp system" (claims 14, 29 and 44) and "to a thickness of about 20 Å - 80 Å" (claims 15, 30 and 45).

The subject matter of claims 2-5, 11-15, 17-20, 26-30, 32-35 and 41-45 would not have been obvious over Chang. Indeed, the Office Action fails to establish a *prima facie* case of obviousness. First, not all claim limitations are taught or suggested by the prior art, considered alone or in combination. Chang does not disclose a method of "forming an insulating layer . . . comprising a *first oxide layer* over the first conductor layer, a nitride layer over the first oxide layer, and a *second oxide layer* over the nitride layer . . . formed by oxidizing said nitride layer with an ambient containing atomic oxygen," as independent claim 1 recites (emphasis added). As noted above, Chang teaches the formation of a *single* interpoly dielectric layer by depositing an initial oxide layer and then subjecting *the same initial oxide layer* to an ammonia annealing and a wet oxidation, to eliminate therefore the need for a three-layer ONO structure. Chang also does not disclose

a "method of forming an ONO insulating structure," as independent claim 16 recites, or a "method of forming a flash memory array," as independent claim 31 recites.

Second, a person skilled in the art would not have been motivated "to use the particular apparatus used to perform the process (in the claimed invention) . . . for the process of Chang et al.," as the Office Action mistakenly asserts. (November 1, 2001 Office Action at 4). As noted above, the crux of Chang is replacing "ONO films for high integrated flash memory devices" with "ammonia annealed and wet oxidized LPCVD oxide." On the other hand, the claimed invention relates to the formation of an insulating structure which retains the three-layer characteristics of a conventional ONO structure. It is clear, therefore, that there is no motivation for a person of ordinary skill in the art to employ the apparatus and respective parameters of the claimed invention in the Chang's method of forming an LPCVD oxide that is subsequently ammonia annealed and wet oxidized. For the foregoing reasons, the Office Action fails to establish a *prima facie* case for obviousness and withdrawal of the rejection of claims 2-5, 11-15, 17-20, 26-30, 32-35 and 41-45 is respectfully requested.

Claims 7-10, 22-25 and 37-40 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Chang et al. (U.S. Patent No. 6,162,684) ("Chang") in view of Neely et al. (U.S. Patent No. 5,443,863) ("Neely"). The rejection is respectfully traversed.

Claims 7-10, 22-25 and 37-40 depend on independent claims 1, 16 and 31, respectively, and recite that the atomic oxygen "is supplied by ozone source" (claims 7, 22 and 37), by "plasma source" (claims 8, 23 and 38), by "microwave source" (claims 9, 24 and 39) and by "photoexcitation" (claims 10, 25 and 40).

Neely relates to low-temperature surface oxidation processes employing ozone decomposition products formed in a microwave discharge cavity. (Title; Abstract). According to Neely, ozone is first decomposed in a microwave discharge cavity into "ozone decomposition product stream" which are then directed "at the surface of the silicon-containing solid at a temperature under about 300°C." (Col. 3, lines 22-26).

The subject matter of claims 7-10, 22-25 and 37-40 would not have been obvious over Chang in view of Neely. Neither Chang nor Neely teaches or suggests the limitations of independent claims 1, 16 and 31 on which claims 7-10, 22-25 and 37-40 depend. Neither Chang nor Neely teaches or suggests a method of "forming an insulating layer . . . comprising a *first oxide layer* over the first conductor layer, a nitride layer over the first oxide layer, and a *second oxide layer* over the nitride layer . . . formed by oxidizing said nitride layer with an ambient containing atomic oxygen," as independent claim 1 recites (emphasis added). Further, neither Chang nor Neely teaches or suggests a "method of forming an ONO insulating structure," as independent claim 16 recites, much less a "method of forming a flash memory array," as independent claim 31 recites.

The references are also not combinable in view of the diverse areas involved in each reference. Chang refers to a method of forming a flash memory cell which employs an "ammonia annealed and wet oxidized LPCVD oxide" which replaces "ONO films for high integrated flash memory devices" and which is formed at temperatures of "from about 600° C to about 850° C." (Abstract). Neely, on the other hand, refers to a method of forming "highly energetic excited states of atomic oxygen which can efficiently oxidize materials at a temperature far less than that needed for purely thermal oxidation" and which are "quite moderate surface temperatures, often under 100°C." (Abstract). It is clear, therefore, that the rejection is based on picking and choosing selected portions of each reference, in an attempt to improperly use hindsight to reconstruct the invention. Accordingly, a person skilled in the art would not have been motivated to combine Chang with Neely and withdrawal of this rejection is respectfully requested.

In view of the above, each of the presently pending claims in this application is believed to be in immediate condition for allowance. Accordingly, the Examiner is respectfully requested to withdraw the outstanding rejection of the claims and to pass this application to issue.

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Respectfully submitted,

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